

Beyond Gee-Whiz Statistics:

Guiding Transportation Investments with Transportation System Performance Measures

presented by

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Presentation Overview

- **Why Bother With Performance Measures?**
- **Where We've Been**
- **Advances in Metrics and Data**
- **Opportunities for Performance Measures to Guide Investment -- Focus on Operations investments**

Congestion Performance: Why Bother?

■ Sound Business Practice

- Private sector has embraced performance measures as a way to:
 - Better serve customers
 - Assess return on investment
- “Know where you are before you decide where to go”

■ Use of Performance Measures Becoming More Widespread and Accepted as Best Practice

- Well established in pavement and bridge management
- Service-oriented measures increasingly being used in State and MPO Long Range Plans

Why Bother? (cont.)

- **Accountability**
 - **Broader customer base for performance measures**
 - **Decision-makers and public becoming increasingly more interested in “how are we doing?”**
- **Becoming easier to do with new technologies**
- **Challenges:**
 - **How to apply concepts worked out in private sector and transportation planning to real-time Operations**
 - **Moving beyond simple reporting of trends**

Where We've Been

- Performance measures have always been used to some degree in transportation planning, but at a simplified scale...
 - V/C, travel time/delay studies
- ... But suffer from data problems
 - Indirect measurement (traffic volumes as a surrogate)
 - Travel demand forecasting models
 - Small samples, infrequent surveys

ADVANCES IN DATA AND METRICS

What Are We Measuring?

- **Congestion**
 - **What happens on facilities**
- **Mobility**
 - **What happens to users -- how they experience the transportation system (trips)**
- **Accessibility**
 - **Interaction of transportation system and activities (opportunities)**
- **Congestion and Mobility can use similar metrics**

Metrics for Performance Monitoring

- System performance tracked at the level of the user (trip) and facility (corridor)
- Understandable to professionals and public
- Multiple metrics to capture full range
- Existing data and methods, preferably through continuous monitoring
- Integration with other transportation functions

Direct Measurement

Continuous

probe vehicles

Special Studies

instrumented cars

Indirect Measurement/Modeling

Continuous

ITS roadway
equipment

spot speeds

transformation

Special Studies

short-term
traffic counts

volumes

models

forecasting
models

Post-processors
(IDAS)

Travel Time

(route segments or trips)

Performance Measures

roadway characteristics
ideal travel conditions
volumes

average travel
speed (mph)

travel time
(min)

travel rate
(min/mile)

indices

- travel rate index
- traffic temperature
- congestion severity

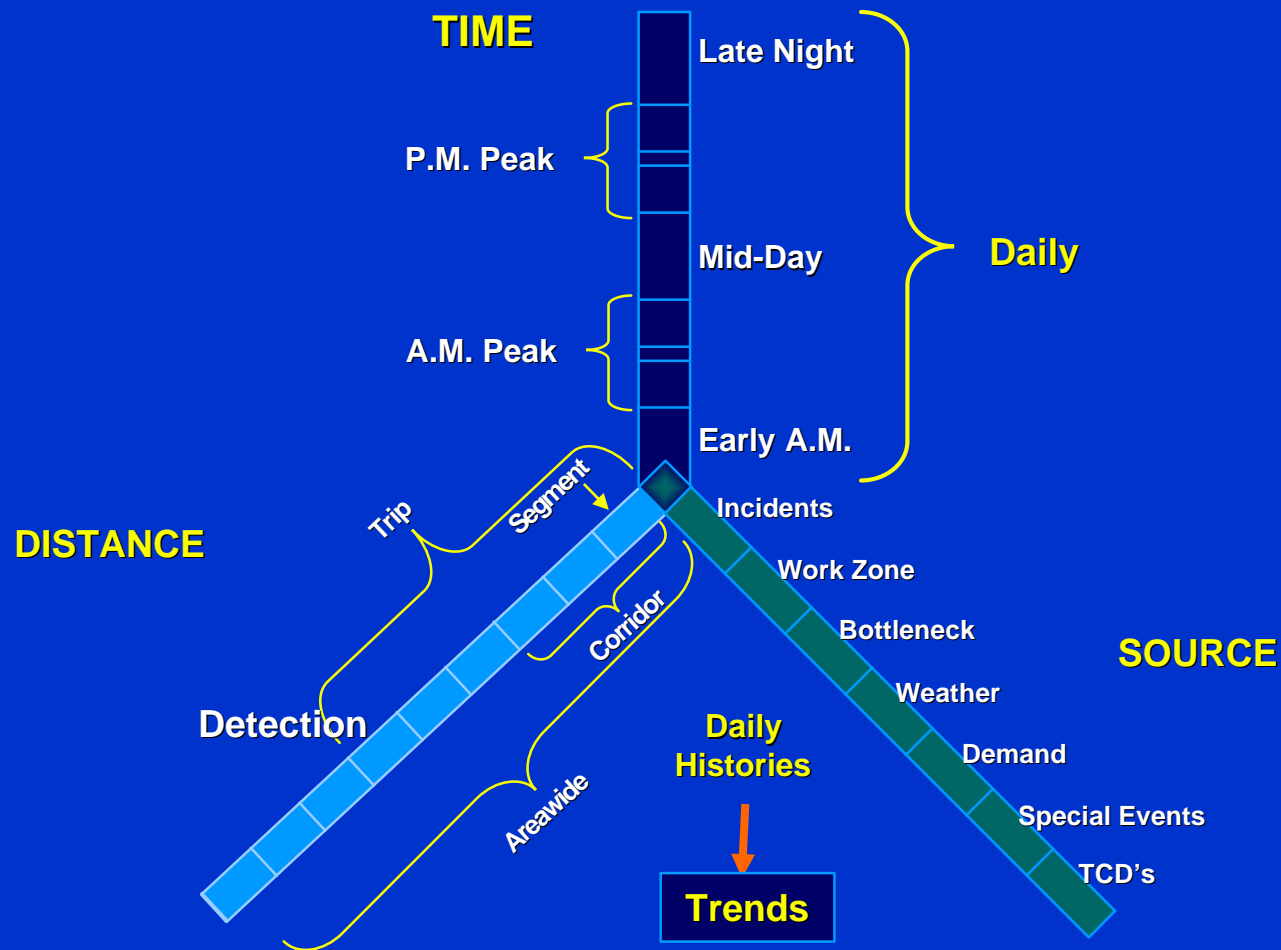
delay (min)

- per vehicle
- per person
- per VMT
- per driver

absolute measures

relative measures

Performance Measures Should Encompass Multiple Dimensions



Recommended Measures: Basic

- **Travel Rate Index (TRI)**
ratio of: $\frac{\text{travel rate in peak}}{\text{ideal travel rate}}$
- **Delay per Driver**
- **Percent of Congested Travel**
 - **%VMT where speeds < 45 mph (fwy)**

Travel Time Reliability: Definition

- Measured by how travel time of a trip varies from one time period to another
 - In other words, reliability is measured as the variability of travel times
 - “How long will my trip take today compared to the same trip at the same time on any average day?”

OR

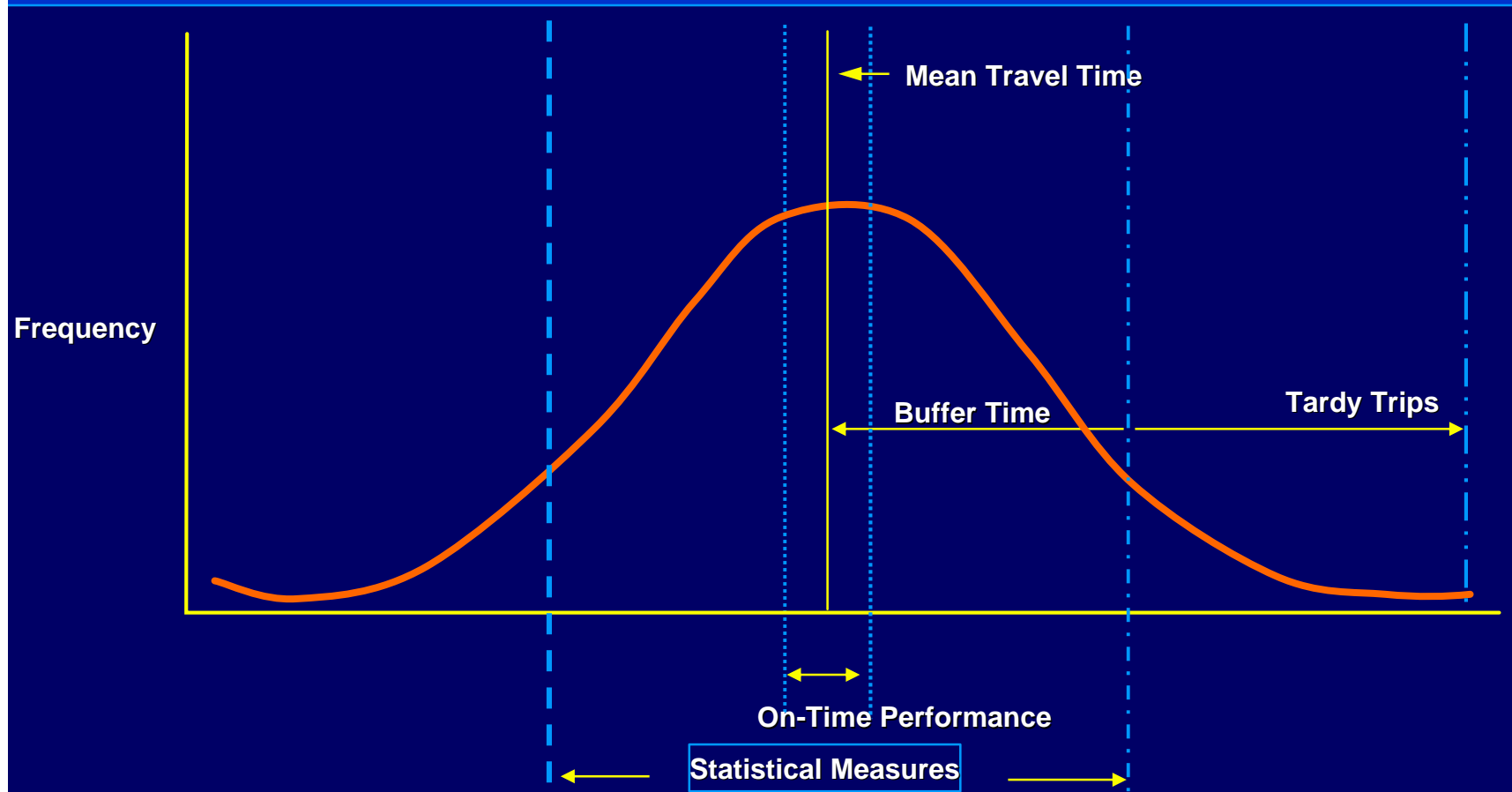
- Ability of travelers to predict travel time for a trip and to arrive at destination within an “on-time window”
- Variability caused by the “Seven Sources” of congestion

Categories of Reliability Measures

There are three categories of reliability measures

- **Statistical**
- **Buffer time**
- **“Tardy arrival”**

Travel Time Distribution and Reliability Measures



Buffer Index

- Weighted average of . . .

$$\frac{95^{\text{th}} \% \text{ Travel Rate} - \text{Average Travel Rate}}{\text{Average Travel Rate}}$$

- The extra time needed to arrive on time
- Seems to resonate with practitioners

Measuring Reliability

■ **Field measurement**

- **Requires many samples or, ideally, continuous measurement**
- **Roadway performance versus trip performance**
 - Different technologies and measurement scale
- **Hard to separate out “root causes” due to complex interactions**
 - Requires combination of travel time and “event” data

■ **Modeling methods**

- **Tend to regress to average conditions**
- **May be useful in decomposing reliability into sources**

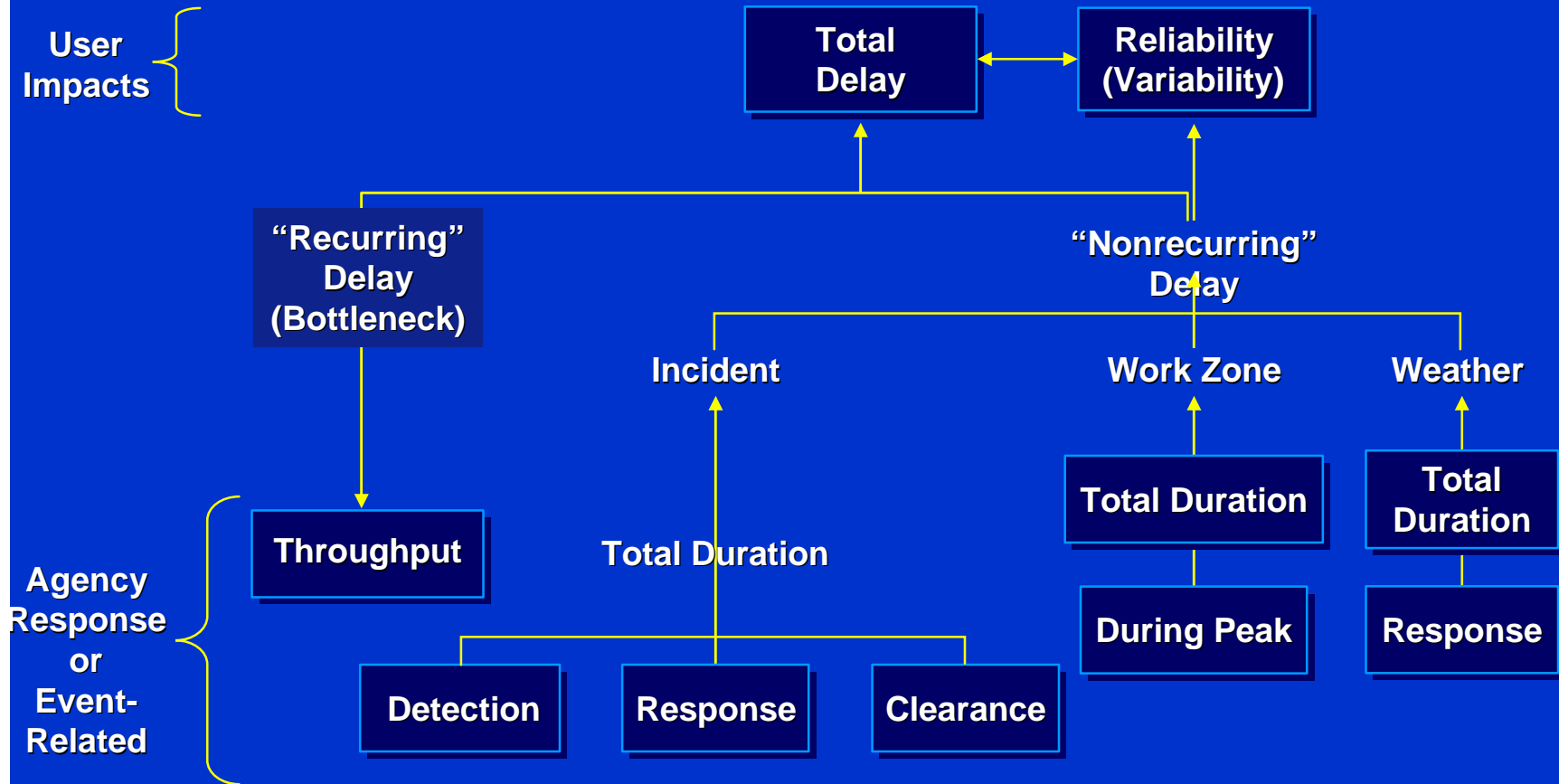
Intermediate or Surrogate Performance Metrics

- **Examples:**
 - **Incident duration and “timeline”**
 - **Clearance time for snowy roads**
- **Easier to develop**
- **More understandable to profession**

BUT

- **Don't get to the bottom-line as effectively as travel time measures**

The “Family Tree” of Performance Measures



Data Issues Associated With Detailed Performance Measures

Secondary Use of Operations a tremendous data source, BUT...

Limited primarily to freeways in major urban areas

Archiving and data quality are problematic

Measurement limited to facility performance or “corridor-trips”

Comparability of measures calculated from continuous Operations data vs. “traditional” or “synthetic” methods

OPPORTUNITIES TO GUIDE INVESTMENT

Performance Measures Can Be Applied At Several Levels of Interest

■ Real-Time Operations

- What is happening now; expected to happen shortly
- How do we respond to travel/system conditions; what strategies do we implement?
 - Incident response, traveler information (esp. advanced guidance)

■ Operations Planning

- What we expect to happen next week/next month
- How can we adjust our strategies to be more responsive
 - New coordination plans, pre-deployment, routing plans

Performance Measures Can Be Applied At Several Levels of Interest

- Short-Term Planning and Programming - 1-5 years (TIP, ITS Deployment Plans and Architectures)
- Long-Term Planning - 5-20 years (Long-Range Plans)

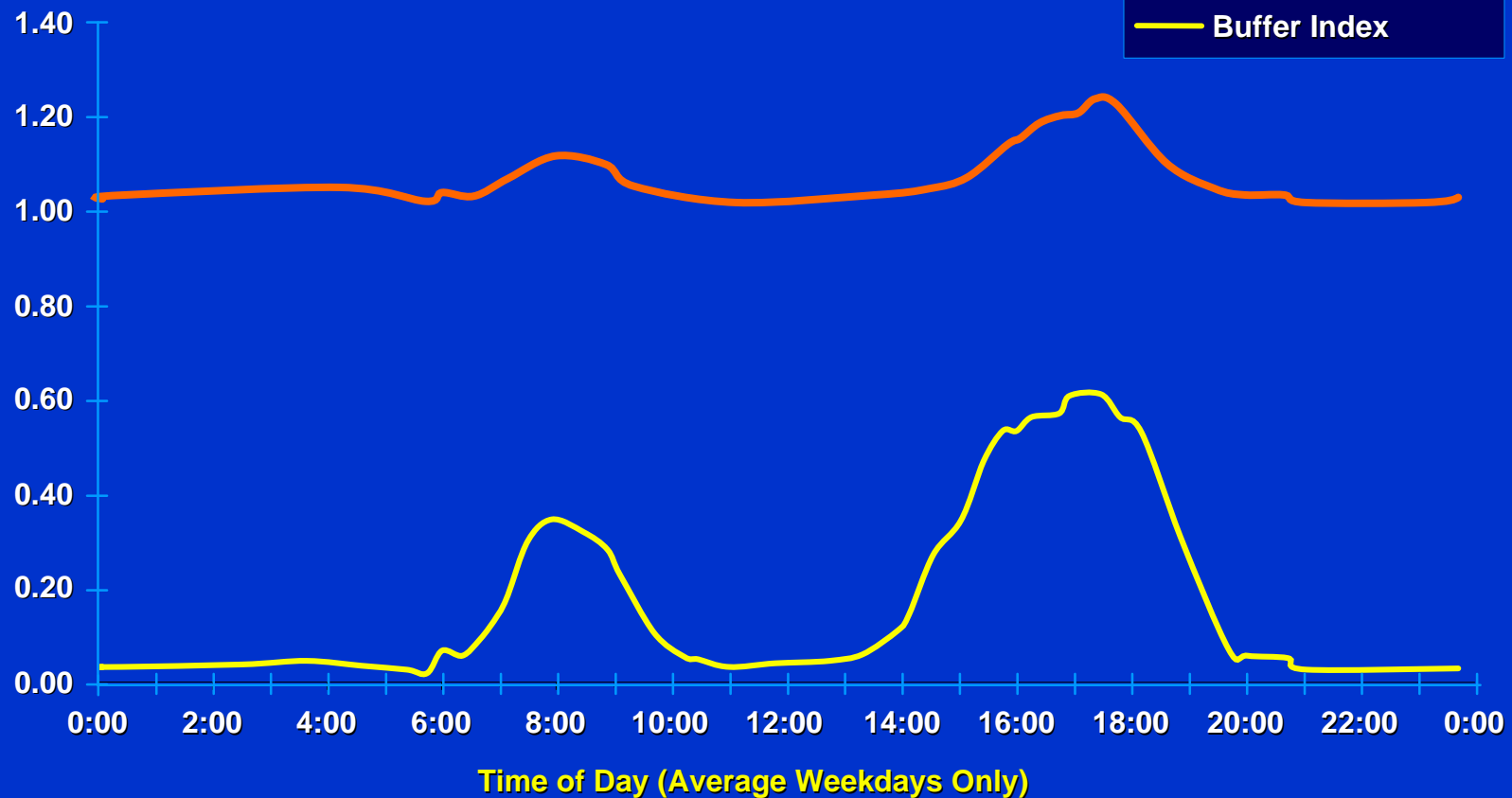
Expected impacts on the “family” of performance measures can help in deciding priorities and trade-offs

- Models need to be sensitive to performance measures, especially reliability and the “Seven Sources”

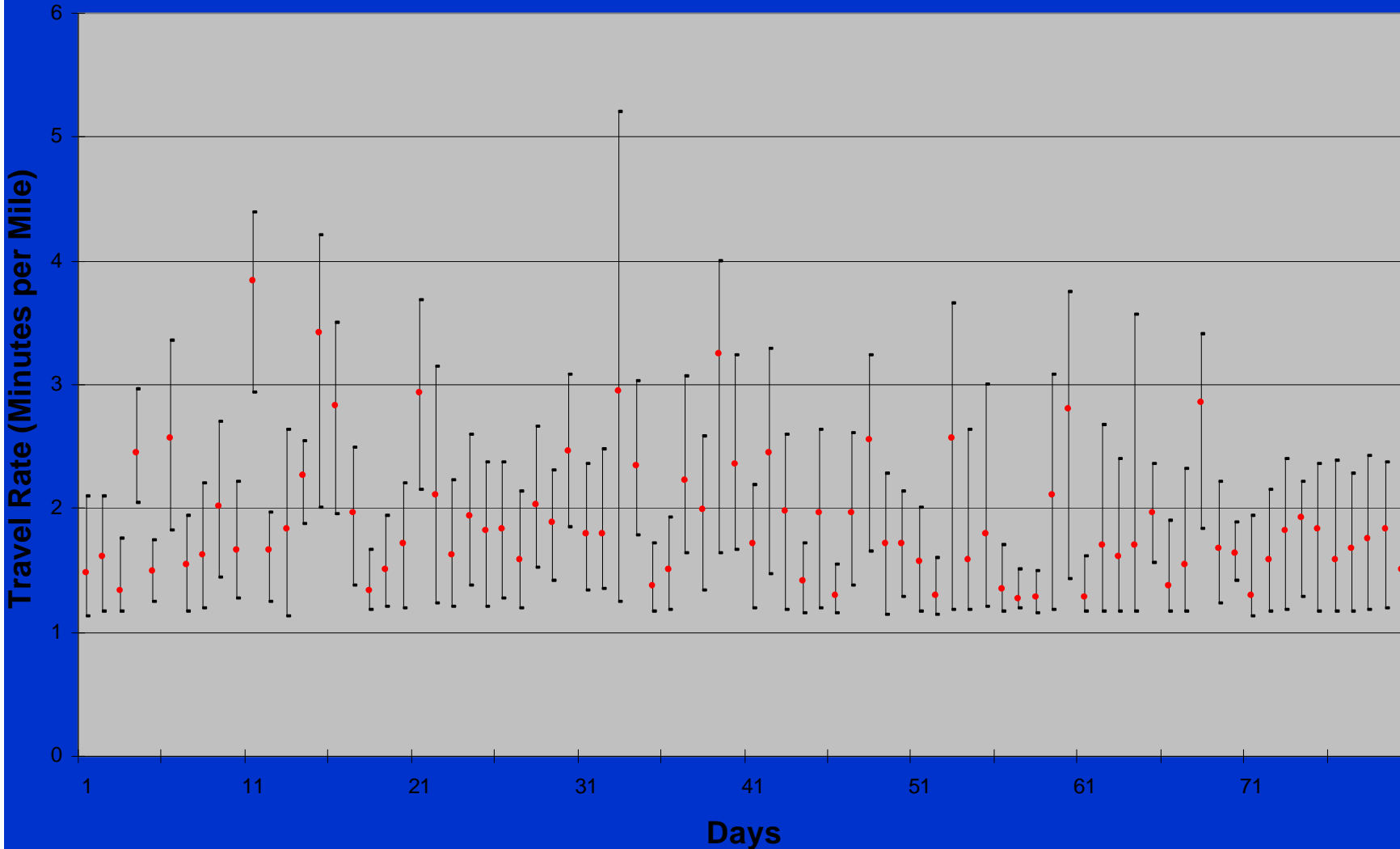
Measuring Reliability (continued)

Atlanta, Georgia TrTI/Buffer Index by Time-of-Day

Index Value or
Congested Travel (1.0=100%)



Orlando Eastbound I-4, Evening Peak Period, Weekdays



SUMMARY

■ **Metrics**

- **Numerous travel-time based metrics are available**
- **Local conditions will indicate which ones are best, but multiple metrics should be used to meet a variety of needs**
- **Summary metrics good for “report card”**
- **Decomposing metrics by at least 3 dimensions is very useful for investment decisions**
 - **Time/Space/Source**
 - **Reliability becoming increasingly important**
- **“Family Tree” of metrics, with output measures at the bottom feeding into user-based measures should be developed**

SUMMARY (cont.)

■ **Data to Support Metrics**

- **Operations sources can provide the data to support this level of detail, but barriers exist**
 - Data quality, coverage, consistency
- **Models do not now provide emerging performance metrics, especially Reliability**

■ **Investment Decisions**

- **Currently, short-range decisions most easily supported**
- **Profession needs to evolve toward a broader framework using the full range of performance measures for all levels of investment, from the “here and now” to long-range planning**